

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

- 1 1. (Currently amended) A method for communicating between a first
2 semiconductor die and a second semiconductor die through optical signaling,
3 comprising:
4 converting an electrical signal into an optical signal using an electrical-to-
5 optical transducer located on a face of the first semiconductor die, wherein the
6 ~~electrical-to-optical transducer is a member of a plurality of electrical-to-optical~~
7 ~~transducers associated with a given channel located on the first semiconductor~~
8 ~~die;~~
9 wherein the first semiconductor die and the second semiconductor die are
10 oriented face-to-face so that the optical signal generated on the first
11 semiconductor die shines on the second semiconductor die;
12 passing the optical signal through annuli located within metal layers on the
13 first semiconductor die to focus the optical signal onto the second semiconductor
14 die;
15 receiving the optical signal on a face of the second semiconductor die; and
16 converting the optical signal into a corresponding electrical signal using an
17 optical-to-electrical transducer located on the face of the second semiconductor
18 ~~die, wherein the optical-to-electrical transducer is a member of a plurality of~~
19 ~~optical-to-electrical transducers associated with the given channel located on the~~
20 ~~second semiconductor die;~~

21 wherein a plurality of optical signals is transmitted in parallel from the
22 first semiconductor die to the second semiconductor die are electronically steered
23 to correct misalignments between the first semiconductor die and the second
24 semiconductor die.

1 2. (Cancelled)

1 3. (Original) The method of claim 1, wherein after generating the optical
2 signal on the first semiconductor die, the method further comprises using a lens to
3 focus the optical signal onto the second semiconductor die.

1 4. (Original) The method of claim 1, wherein after generating the optical
2 signal on the first semiconductor die, the method further comprises using a mirror
3 to reflect the optical signal, so that the optical signal can shine on the second
4 semiconductor die without the first semiconductor die having to be coplanar with
5 the second semiconductor die.

1 5-6 (Canceled).

1 7. (Previously presented) The method of claim 1,
2 wherein multiple spatially adjacent electrical-to-optical transducers in the
3 plurality of electrical-to-optical transducers transmit the same signal; and
4 wherein electronic steering circuits in the first semiconductor die direct
5 data to the multiple spatially adjacent electrical-to-optical transducers to correct
6 mechanical misalignment in X , Y and θ coordinates.

1 8. (Previously presented) The method of claim 1,

2 wherein multiple spatially adjacent optical-to-electrical transducers in the
3 plurality of optical-to-electrical transducers receive the same signal; and
4 wherein electronic steering circuits in the second semiconductor die direct
5 data from the multiple spatially adjacent optical-to-electrical transducers to correct
6 mechanical misalignment in X , Y and Θ coordinates.

1 9. (Original) The method of claim 1, wherein the electrical-to-optical
2 transducer includes one of:
3 a Zener diode;
4 a light emitting diode (LED);
5 a vertical cavity surface emitting laser (VCSEL); and
6 an avalanche breakdown P-N diode.

1 10. (Original) The method of claim 1, wherein the optical-to-optical
2 transducer includes one of:
3 a P-N-diode photo-detector; and
4 a P-I-N-diode photo-detector.

1 11. (Currently amended) An apparatus for communicating between
2 semiconductor chips through optical signaling, comprising:
3 a first semiconductor die;
4 a second semiconductor die;
5 an electrical-to-optical transducer located on a face of the first
6 semiconductor die, which is configured to convert an electrical signal into an
7 optical signal, wherein the electrical-to-optical transducer is a member of a
8 plurality of electrical-to-optical transducers associated with a given channel
9 located on the first semiconductor die;

10 wherein the first semiconductor die and the second semiconductor die are
11 oriented face-to-face so that the optical signal generated on the first
12 semiconductor die shines on the second semiconductor die;
13 annuli located within metal layers on the first semiconductor die
14 configured to focus the optical signal onto the second semiconductor die;
15 an optical-to-electrical transducer located on a face of the second
16 semiconductor die, which is configured to convert the optical signal received from
17 the first semiconductor die into a corresponding electrical signal, ~~wherein the~~
18 ~~optical-to-electrical transducer is a member of a plurality of optical-to-electrical~~
19 ~~transducers associated with the given channel located on the second~~
20 ~~semiconductor die;~~
21 ~~wherein a plurality of optical signals is transmitted in parallel from the~~
22 ~~first semiconductor die to the second semiconductor die are electronically steered~~
23 ~~to correct misalignments between the first semiconductor die and the second~~
24 ~~semiconductor die.~~

1 12. (Cancelled)

1 13. (Original) The apparatus of claim 11, further comprising a lens
2 configured to focus the optical signal onto the second semiconductor die.

1 14. (Original) The apparatus of claim 11, further comprising a mirror
2 configured to reflect the optical signal, so that the optical signal can shine on the
3 second semiconductor die without the first semiconductor die having to be
4 coplanar with the second semiconductor die.

1 15-16 (Canceled).

1 17. (Previously presented) The apparatus of claim 11,
2 wherein multiple spatially adjacent electrical-to-optical transducers in the
3 plurality of electrical-to-optical transducers transmit the same signal; and
4 wherein electronic steering circuits in the first semiconductor die direct
5 data to the multiple spatially adjacent electrical-to-optical transducers to correct
6 mechanical misalignment in X , Y and θ coordinates.

1 18. (Previously presented) The apparatus of claim 11,
2 wherein multiple spatially adjacent optical-to-electrical transducers in the
3 plurality of optical-to-electrical transducers receive the same signal; and
4 wherein electronic steering circuits in the second semiconductor die direct
5 data from the multiple spatially adjacent optical-to-electrical transducers to correct
6 mechanical misalignment in X , Y and θ coordinates.

1 19. (Original) The apparatus of claim 11, wherein the electrical-to-optical
2 transducer includes one of:
3 a Zener diode;
4 a light emitting diode (LED);
5 a vertical cavity surface emitting laser (VCSEL); and
6 an avalanche breakdown P-N diode.

1 20. (Original) The apparatus of claim 11, wherein the optical-to-optical
2 transducer includes one of:
3 a P-N-diode photo-detector; and
4 a P-I-N-diode photo-detector.

1 21. (Currently amended) A computer system including semiconductor
2 chips that communicate with each other through optical signaling, comprising:

3 a first semiconductor die containing one or more processors;
4 a second semiconductor die containing circuitry that communicates with
5 the one or more processors;
6 an electrical-to-optical transducer located on a face of the first
7 semiconductor die, which is configured to convert an electrical signal into an
8 optical signal, ~~wherein the electrical-to-optical transducer is a member of a~~
9 ~~plurality of electrical-to-optical transducers associated with a given channel~~
10 ~~located on the first semiconductor die;~~
11 wherein the first semiconductor die and the second semiconductor die are
12 oriented face-to-face so that the optical signal generated on the first
13 semiconductor die shines on the second semiconductor die;
14 annuli located within metal layers on the first semiconductor die
15 configured to focus the optical signal onto the second semiconductor die;
16 an optical-to-electrical transducer located on a face of the second
17 semiconductor die, which is configured to convert the optical signal received from
18 the first semiconductor die into a corresponding electrical signal, ~~wherein the~~
19 ~~optical-to-electrical transducer is a member of a plurality of optical-to-electrical~~
20 ~~transducers associated with the given channel located on the second~~
21 ~~semiconductor die;~~
22 ~~wherein a plurality of optical signals is be transmitted in parallel from the~~
23 ~~first semiconductor die to the second semiconductor die are electronically steered~~
24 ~~to correct misalignments between the first semiconductor die and the second~~
25 ~~semiconductor die.~~

1 22. (Cancelled)

1 23. (Original) The computer system of claim 21, further comprising a lens
2 configured to focus the optical signal onto the second semiconductor die.

1 24. (Original) The computer system of claim 21, further comprising a
2 mirror configured to reflect the optical signal, so that the optical signal can shine
3 on the second semiconductor die without the first semiconductor die having to be
4 coplanar with the second semiconductor die.

1 25-26 (Canceled).

1 27. (Previously presented) The computer system of claim 21,
2 wherein multiple spatially adjacent electrical-to-optical transducers in the
3 plurality of electrical-to-optical transducers transmit the same signal; and
4 wherein electronic steering circuits in the first semiconductor die direct
5 data to the multiple spatially adjacent electrical-to-optical transducers to correct
6 mechanical misalignment in X , Y and θ coordinates.

1 28. (Previously presented) The computer system of claim 21,
2 wherein multiple spatially adjacent optical-to-electrical transducers in the
3 plurality of optical-to-electrical transducers receive the same signal; and
4 wherein electronic steering circuits in the second semiconductor die direct
5 data from the multiple spatially adjacent optical-to-electrical transducers to correct
6 mechanical misalignment in X , Y and θ coordinates.

1 29. (Original) The computer system of claim 21, wherein the electrical-to-
2 optical transducer includes one of:
3 a Zener diode;
4 a light emitting diode (LED);
5 a vertical cavity surface emitting laser (VCSEL); and
6 an avalanche breakdown P-N diode.

1 30. (Original) The computer system of claim 21, wherein the optical-to-
2 optical transducer includes one of:
3 a P-N-diode photo-detector; and
4 a P-I-N-diode photo-detector.

1 31. (Previously presented) The method of claim 1, wherein after
2 generating the optical signal on the first semiconductor die, the method further
3 comprises passing the optical signal through an interposer sandwiched between
4 the first semiconductor die and the second semiconductor die, wherein the
5 interposer contains one or more waveguides that direct the optical signal, so that
6 the optical signal shines on the second semiconductor die.

1 32. (Previously presented) The apparatus of claim 11, further comprising
2 an interposer sandwiched between the first semiconductor die and the second
3 semiconductor die, wherein the interposer contains one or more waveguides that
4 direct the optical signal, so that the optical signal shines on the second
5 semiconductor die.

1 33. (Previously presented) The computer system of claim 21, further
2 comprising an interposer sandwiched between the first semiconductor die and the
3 second semiconductor die, wherein the interposer contains one or more
4 waveguides that direct the optical signal, so that the optical signal shines on the
5 second semiconductor die.

1 34. (New) The method of claim 1,
2 wherein the electrical-to-optical transducer is a member of a plurality of
3 electrical-to-optical transducers located on the first semiconductor die; and

4 wherein the optical-to-electrical transducer is a member of a plurality of
5 optical-to-electrical transducers located on the first semiconductor die;
6 whereby a plurality of optical signals can be transmitted in parallel from
7 the first semiconductor die to the second semiconductor die.

1 35. (New) The apparatus of claim 11,
2 wherein the electrical-to-optical transducer is a member of a plurality of
3 electrical-to-optical transducers located on the first semiconductor die; and
4 wherein the optical-to-electrical transducer is a member of a plurality of
5 optical-to-electrical transducers located on the first semiconductor die;
6 whereby a plurality of optical signals can be transmitted in parallel from
7 the first semiconductor die to the second semiconductor die.

1 36. (New) The computer system of claim 21,
2 wherein the electrical-to-optical transducer is a member of a plurality of
3 electrical-to-optical transducers located on the first semiconductor die; and
4 wherein the optical-to-electrical transducer is a member of a plurality of
5 optical-to-electrical transducers located on the first semiconductor die;
6 whereby a plurality of optical signals can be transmitted in parallel from
7 the first semiconductor die to the second semiconductor die.